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INTESTINAL AND BLOOD PARASITES OF MAN IN TIMOR

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Survey tinja dan darah dipulau Timor guna menentukan distribusi dan prevalensi penyakit parasit iantara penduduk telah dilakukan pada bulan Juli dan Agustus tahun 1972 sebagai kelanjutan dari deretan survey yang dilakukan oleh Direktorat Jenderal Pencegahan Pemberantasan Penyakit enular Departemen Kesehatan, Bagian Parasitologi dan Pathologi Umum Fakultas Kedokteran niversitas Indonesia dan US Namru–2 di Indonesia.

Sejumlah 445 sediaan tinja untuk pemeriksaan parasit usus, 581 sediaan darah untuk pemeriksaan rasit malaria dan 663 sediaan darah untuk pemeriksaan parasit filaria telah diambil dari penduduk cara merata di 7 desa pada 3 kabupaten di Timor, Nusa Tenggara Timur.

nam puluh delapan per cent diantara penduduk melihatkan satu atau lebih parasit usus didalam njanya dimana cacing tambang merupakan parasit usus yang terbanyak. Ascaris lumbricoides ketemukan jauh lebih kurang daripada di Jawa, Sumatra dan Sulawesi, juga diketemukan perbedaan tara "intestinal parasite rate" di Timor Indonesia dan Timor Portugis. Dua belas per cent penduduk ng diperiksa melihatkan parasit malaria didalam darahnya sedangkan parasit filaria ditemukan banyak 8 per cent. Plasmodium falciparum merupakan parasit malaria yang terbanyak ditemukan. ua jenis parasit filaria yang ditemukan adalah "Timor microfilaria" dan Wuchereria bancrofti dimana ng pertama merupakan parasit yang terbanyak diantara penduduk yang diperiksa.

Information regarding distribution of human rasites in a greater part of Indonesia is li- ted. This is especially true for the Lesser nda Islands, since there appears to be only e published report on the study of intestinal rasites in Portuguese Timor (Azevedo *et al.*, 58). The present study, which was done ring July and August 1972 to determine rrent status of intestinal and blood parasites Indonesian Timor, is a continuation of a ies of parasitological surveys conducted der auspices of the Director General, CDC,)H, Republic of Indonesia, assisted by De- rtment of Parasitology and General Patholo- gy, Faculty of Medicine, University of Indonesia and by NAMRU-2. Prevalence of intestinal and blood parasites in seven villages from three regencies of Indonesian Timor are reported herein.

Discription of area.

Timor is situated in the Lesser Sunda chain of islands (Fig.).

The eastern half and a small portion of the western half of this island belong to Portugal; the rest of the island belongs to Indonesia.

Kupang, the capital of Indonesian Timor, is located at the southwestern tip of the island. Villages surveyed are identified in The Fig. with Roman numerals. The villages of Tepas, Puna and Loli are located in the South Central Regency; the villages of Wini, Kaubele and Mena are situated in the North Central Regency. One village, Bau Atok, lies in the regency of Belo, which is adjacent to Portuguese Timor.

Wini, Kaubele and Mena are situated on a coastal plain; the altitude of Tepas is between

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100–200 meters, Loli and Puna 200–300 meters and Bau Atok 300–600 meters.

Inhabitants of villages surveyed were all indigenous Timorese, most of whom were converts to Christianity. Corn farming was the primary occupation. At Wini, located on the coast, fishing was also a commercial occupation. Diet consisted of corn, rice, and occasionally meat or fish.

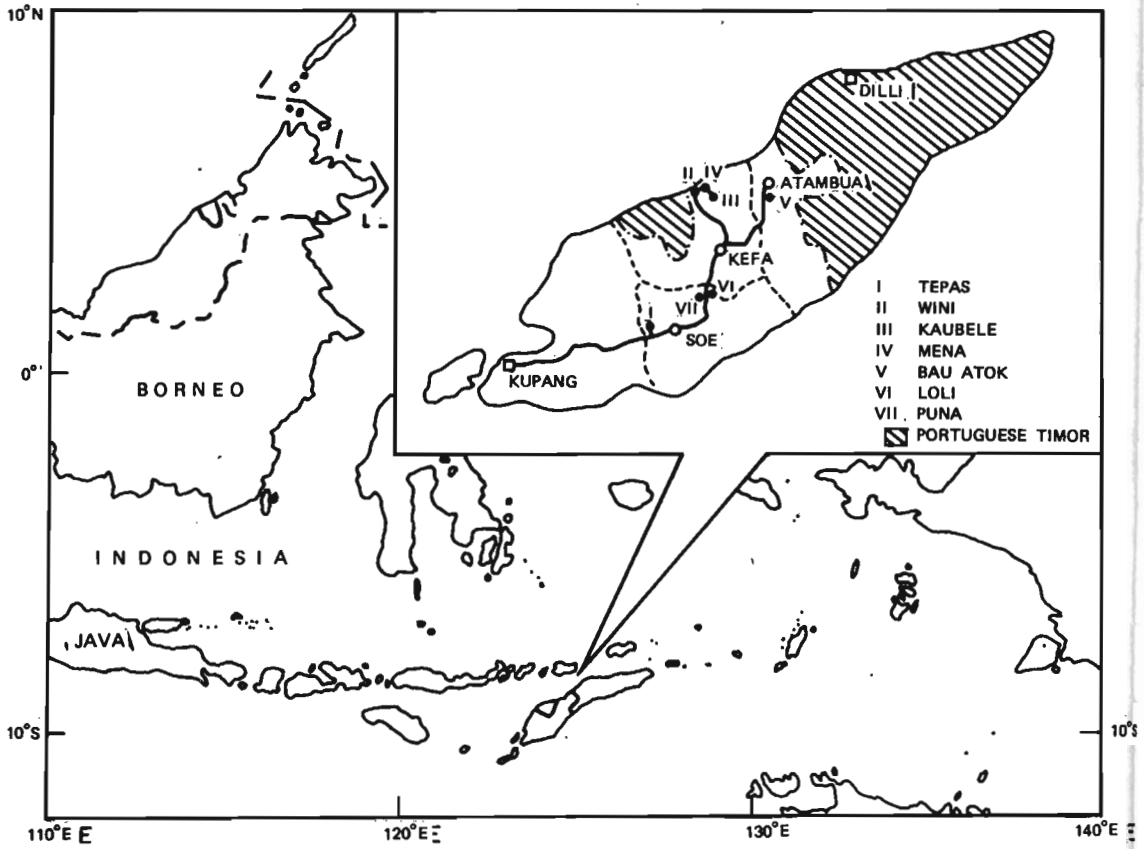

Fig. Map of the Indonesian Archipelago with a blowup of Timor in the Lesser Sunda Islands. Villages surveyed are identified with Roman numerals I through VII.

MATERIALS AND METHODS

Blood specimens were obtained from finger tips between the hours of 20:00 and 22:00. Thick and thin smears were made onto microscope slides and air-dried overnight. Thin smears were fixed in methanol in the field for transporting specimens to Jakarta, and both thin and thick smears were placed in slide boxes which were sealed in plastic bags containing Drierite®. In Jakarta thin and thick preparations were stained in 3–4 per cent Giemsa (pH 6.8–7.0) for 1 hour and thick preparations were dehaemoglobinized while staining. At the time of blood collections, subjects were given cartons and instructed to return the next day with a fecal specimen. One or two grams of feces were obtained, placed into screw-capped bottles containing 15 ml of 10 per cent formalin, and mixed throughly. Specimens were subsequently examined by direct and formalin-ether concentration methods at the NAMRU-2 laboratory in Jakarta. Microscopic examinations of blood

smears for malaria were made at the NAMRU-2 laboratory in Jakarta; filarial determinations were made at the Filariasis Division, CDC, MOH, Jakarta.

RESULTS

A total of 445 stool specimens from seven villages in Indonesian Timor were examined. Sixty-eight per cent of the inhabitants, who ranged in age from 1 to 70 years, were found to be infected with one or more intestinal parasites. Table 1 lists prevalences of intestinal parasites from villages surveyed.

Table 1 Prevalence of intestinal parasite among inhabitants of seven villages on Timor, Indonesia

Parasite	Tepas	Puna	Loli	Wini	Kaubele	Mena	Bau Atok	Total
Entamoeba histolytica	7*	11	20	13	21	6	5	11
Entamoeba hartmanni	5	4	0	2	2	15	0	4
Entamoeba coli	25	71	37	26	15	9	19	27
Endolimax nana	9	32	15	7	4	9	0	9
Iodamoeba butschlii	2	4	2	0	0	12	0	2
Giardia lamblia	5	0	0	4	4	12	11	5
Chilomastix mesnili	3	18	7	1	4	9	4	5
Balantidium coli	0	0	0	1	2	3	0	1
Ascaris lumbricoides	10	0	5	2	2	0	44	10
Trichuris trichiura	1	7	2	1	0	0	0	1
Hookworm	46	29	46	11	36	36	40	35
Enterobius vermicularis	1	7	2	0	0	0	2	1
Unknown nematode	0	0	0	0	2	0	0	0(0.2)
Taenia sp.	2	0	0	10	15	15	9	7
Hymenolepis nana	1	0	0	0	0	0	0	0(0.2)
Dicrocoeliid trematode	0	7	0	0	2	0	0	1
Total number examined	138	28	41	101	47	33	57	445

* Percentages expressed to nearest whole number.

Hookworm (35 per cent) was the most common helminth, while *Trichuris trichiura* and *Ascaris lumbricoides* were found only in 1 and 10 per cent of the population, respectively. *A. lumbricoides*, however, was highly endemic in one village, Bau Atok (44 per cent); it was infrequent or remained undetected in other villages. Likewise, *T. trichiura* was not detected, or seldom found (less than 2 per cent), in all villages except Puna, where 7 per cent of the population sampled were shedding whipworm eggs. Intervillage variations of hookworm infection rates were not striking except for the low infection rate detected in Wini (11 per cent). *Enterobius vermicularis* was found in 1 per cent of the overall population, while in Puna 7 per cent of stools demonstrated *E. vermicularis*. An uknnown nematode was discovered in 2 per cent of Kaubele residents. Taeniid eggs were found in 7 per cent of stools sampled; infections were detected in all villages except Puna and Loli. *Hymenolepis nana* was found in one resident of Tepas and a dicrocoeliid-like egg was found in one Kaubele and two Puna residents.

Entamoeba coli (27 per cent) was the most frequently encountered intestinal protozoan. Less frequently detected intestinal protozoans were: *E. histolotica* (11 per cent), *E. hartmanni* (4 per cent), *Endolimax nana* (9 per cent), *Iodamoeba butschlii* (2 per cent), *Giardia lamblia* (5 per cent), *Chilomastix mesnili* (5 per cent), and *Balantidium coli* (1 per cent).

Most parasites were equally distributed among 234 males and 211 females examined (Table 2); variations by sex were less than five percentage points. In Table 3, prevalences of

intestinal parasites are listed by age.

Table 2 Prevalence of intestinal parasites by sex among inhabitants of seven villages on Timor, Indonesia

Parasite	Male	Female
Entamoeba histolytica	10*	11
Entamoeba hartmanni	3	5
Entamoeba coli	27	26
Endolimax nana	11	7
Iodamoeba butschlii	1	3
Giardia lamblia	7	3
Chilomastix mesnili	3	7
Balantidium coli	0(0.4)	1
Ascaris lumbricoides	9	11
Trichuris trichiura	2	0
Hookworm	37	32
Enterobius vermicularis	1	1
Unknown nematode	0(0.4)	0
Taenia sp.	8	5
Hymenolepis nana	0	0(0.4)
Dicrocoeliid trematode	1	0
Total number examined	234	211

* Percentages expressed to nearest whole number.

Hookworm infection rates appread to increase with age, as did infections with taeniid tapeworms and *E. nana. T. trichiura* was found only in the 10–to–29 year agr groups. Ascariasis was infrequent in all age groups.

Altitudinally, there did not appear to be any consistent pattern in the distribution of intestinal helminth and protozoan parasites. Villages surveyed were from sea level to 300–600 meters in elevation.

Among 581 blood smears examined, malaria parasitemias were detected in 69 individuals (Table 4).

Plasmodium falciparum was endemic in all villages surveyed. *P. vivaz* was found in all villages except Mena, Puna and Bau Atok, while *P. malariae* was detected in all villages except Wini, Mena and Kaubele. Three cases of mixed infections of *P. vivax* and *P. falciparum* were found in Tepas. Mixed infections of *P. malariae* and *P. falciparum* were likewise diagnosed in 3 persons from Tepas and in one individual from Wini. One case of mixed *P. malariae* and *P. vivax* was found in Mena. The overall preva-

Table 3 Prevalence of intestinal parasites by age among inhabitants of seven villages on Timor, Indonesia

Parasite	Age in Years					
	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 –
Entamoeba histolytica	11*	10	10	14	10	8
Entamoeba hartmanni	2	4	3	4	2	8
Entamoeba coli	25	29	20	36	22	22
Endolimax nana	9	8	3	13	14	14
Iodamoeba butschlii	1	1	5	0	6	0
Giardia lamblia	5	9	6	4	0	0
Chilomastix mesnili	5	3	4	6	10	0
Balantidium coli	0	1	1	0	2	0
Ascaris lumbricoides	12	9	10	11	6	8
Trichuris trichiura	0	1	5	0	0	0
Hookworm	14	35	44	41	41	42
Enterobius vermicularis	1	0	0	3	2	3
Unknown nematode	0	0	1	0	0	0
Taenia sp.	1	3	11	13	10	6
Hymenolepis nana	1	0	0	0	0	0
Dicrocoeliid trematode	0	0	1	1	2	0
Total number examined	83	117	80	70	49	36

* Percentages expressed to nearest whole number.

Table 4 Prevalence of malaria among inhabitants of seven villages in Timor, Indonesia

Parasite	Tepas	Puna	Loli	Wini	Kaubele	Mena	Bau Atok	Total
Plasmodium vivax	5*	0	2	6	3	0	0	3
Plasmodium falciparum	8	19	8	2	6	2	3	6
Plasmodium malariae	1	2	4	0	0	0	1	1
P. vivax & P. falciparum	3	0	0	0	0	0	0	1
P. malariae & P. falciparum	2	0	0	1	0	0	0	1
P. malariae & P. vivax	0	0	0	0	0	2	0	0(0.2)
Total percentage of malaria	18	21	15	9	9	4	4	12
Total number examined	166	52	48	105	65	45	100	581

* Percentages expressed to nearest whole number.

Table 5 Prevalence of malaria by age among inhabitants of seven villages on Timor, Indonesia

Parasite	Age in Years					
	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 –
Plasmodium vivax	11*	0	0	1	0	0
Plasmodium falciparum	16	2	4	6	3	2
Plasmodium malariae	1	1	1	1	0	0
P. vivax & P. falciparum	4	0	0	0	0	0
P. malariae & P. falciparum	3	0	0	0	0	0
P. malariae & P. vivax	1	0	0	0	0	0
Total percentage of malaria	36	2	5	8	3	2
Total number examined	143	133	110	91	61	43

* Percentages expressed to nearest whole number

Table 6 Prevalence of malaria by sex among inhabitants of seven villages in Timor, Indonesia.

Parasite	Male	Female
Plasmodium vivax	3*	3
Plasmodium falciparum	7	6
Plasmodium malariae	1	0(0.4)
P. vivax & P. falciparum	1	1
P. malariae & P. falciparum	1	1
P. malariae & P. vivax	0(0.4)	0
Total percentage of malariae	12	12
Total number examined	305	276

* Percentages expresses to nearest whole number.

lence rate of all species of malaria was 12 per cent, while seventy-four per cent of cases were in children nine years of age or younger (Table 5), and parasitemias were equally distributed among males anf females (Table 6).

Two types of microfilariae were found: *Wuchereria bancrofti* and the Timor microfilaria. The later was the most common filarid parasite encountered (Table 7). Timor microfilariae were diagnosed in all villages surveyed except for Puna and Bau Atok. The highest concentration of Timor microfilaria cases were found in costal villages: Mena (18 per cent), Kaubele (6 per cent) and Wini (12 per cent). Likewise, *W. bancrofti* was most prevalent in the costal village of Wini (11 per cent). Mixed infections were diagnosed at Wini, Kaubele and Loli.

Generally, the prevalence of microfilaremia increased with age (Table 8), and in the case of

Table 7 Prevalence of microfilaria among inhabitants of seven villages in Timor, Indonesia

Parasite	Tepas	Puna	Loli	Wini	Kaubele	Mena	Bau Atok	Tota
Wuchereria bancrofti	0	0	0	5*	0	0	0	1
Timor filaria	6	0	10	6	5	18	0	6
Timor filaria + *W. bancrofti*	0	0	2	6	1	0	0	1
Total percentage of microfilaria	6	0	12	17	7	18	0	8
Total number examined	203	52	50	108	75	49	126	663

* Percentages expressed to nearest whole number.

Table 8 Prevalence of microfilaria by age inhabitants of seven villages in Timor, Indonesia

Parasite	Age in Years					
	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 –
Wuchereria bancrofti	0	0	1*	3	0	0
Timor filaria	2	1	8	9	10	13
W. bancrofti + Timor filaria	1	0	1	2	3	4
Total percentage of microfilaria	2	1	9	14	14	16
Total number examined	168	149	119	100	72	55

* Percentages expressed in nearest whole number.

Table 9 Prevalence of microfilaria by sex among inhabitants of seven villages in Timor, Indonesia

Parasite	Male	Female
Wuchereria bancrofti	1*	1
Timor filaria	7	4
W. bancrofti and Timor filaria	1	1
Total percentage of microfilaria	9	6
Total number examined	353	310

* Percentages expressed to nearest whole number.

Timor microfilaria, more infections were reported from males than females (Table 9).

A concurrent mosquito survey by one of us (Hoedojo) yielded the following anopheline species: *Anopheles aconitus, A. barbirostris, A tesselatus,* and *A. vagus.* Their respective roles in the transmission of malaria and filariasis in Timor were not determined.

DISCUSSION

Intestinal parasites were noticeably un common in Indonesian Timor, when compare to results of recent surveys on island such a Java, Sumatra, and Sulawesi (Cross *er al.*, 1970 1972; Clarke *et al.*, 1973a; 1973b; Carney *e al.*, 1974a; 1974b; 1974c).

Soil transmitted helminth associations, disco vered in Timor, compared more closely wit results obtained in isolated areas of Centra Sulawesi (Clarke *et al.*, 1974; Carney *et al.* 1974d; 1974e).

An interesting contrast was noted betwee results found in Portuguese Timor (Azevedo, *e al.*, 1958) and the present study.

In Portuguese Timor *A. lumbricoides* was quit common (24.4 per cent), while in Indonesi Timor the overall prevalence was much lowe (10 per cent). On the other hand, hookwor was highly endemic in Indonesian Timor (35

per cent) and relatively uncommon in Portuguese Timor (8.3 per cent). Trichuriasis was found in only 1 per cent of the Indonesian stool specimens, while 5.6 per cent of Portuguese specimens contained *T. trichiura* eggs. *E. vermicularis* was uncommon in both areas (1 per cent) or less), but neither study employed methods noted for high recovery of pinworm eggs.

To our knowledge there are no previous reports of tapeworms or trematodes in the human population of Timor. *Taenia* sp., however, have been reported elsewhere in humans from Indonesia.

Hadidjaja (1971) recently reported 16 cases of taeniasis in Jakarta in persons originally from North Sumatra, Java, Bali, North Sulawesi, and Southeast Sulawesi. According to Tumada and Margono (1973), 9 per cent of the stools of hospitalized patients from the Wissel Lake's area of Irian Jaya (West Irian) contained taeniid eggs. Adult worms expelled by these patients were subsequently identified as *T. solium.*

H. nana was found in one female child from Tepas. This low prevalence compares with recent surveys in Java and Sumatra (Kwo and Jo, 1965; Tjiong and Oemijati, 1968 and Cross, *et al.*, 1970). Tumada and Margono (1973), however, reported and 8 per cent infection rate in hospitalized -and out-patients of Enarotali hospital in the Paniai highlands, Irian Jaya.

There has been only one published report of a dicrocoeliid in humans from Indonesia and this infection was most likely acquired in Europe (Brug, 1918). Although three cases were discovered in widely separated villages, Puna and Kaubele, they may be spurious; multiple stools were not examined.

Humans may acquire dicrocoeliids by accidentally or intentionally ingesting arthropods, which harbor the metacercarial stage of these trematodes. Spurious dicrocoeliid infections can be contracted through ingestion of liver, gall bladder, or pancreatic tissue of mammals harboring dicrocoeliid indections. John H. Cross (personal communication, 1974) reported finding dicrocoeliid-like eggs in people from Taiwan, the Philippines, and Indonesia that he felt might be didymozoid eggs which were obtained by eating marine flying fish. Recently, there have been a number of reports of didymozoid eggs in human feces which might easily be confused with dicrocoeliid eggs (Bergner *et al.*, 1973; Suriel Smeets and Schouten, 1972; Schouten *et al.*, 1968; Kamejai, 1971).

However, the villages in which the dicrocoeliid-like eggs were found are not located on the coast. Puna is situated near the center of the island and Kaubele approximately 25 kilometers from the north coast. Thus, if the infections are spurious, the most likely are dicrocoeliids. *Eurytrema pancreaticum* is a common parasite of cattle in Indonesia. Ingestion of pancreatic tissue of infected cattle would produce a spurious dicrocoeliid infection.

E. histolytica and *G. lamblia* were the only intestinal protozoans reported from Portuguese Timor by Azevedo *et al.* (1958). In Portuguese Timor prevalence rates of *E. histolytica* ranged from 4.5 to 10.7 per cent, while in our study the rates ranged from 5–20 per cent with an average of 11 per cent. Likewise, in Portuguese Timor *G. lamblia* the rates varied from 1.5 to 5.9 per cent, while in Indonesian Timor we found a wider range, 0–12 per cent with an average of 5 per cent. To our knowledge this paper represents the first record of *E. hartmanni, E. coli, E. nana. I. butschlii, C. mesnili* and *B. coli* in humans from the island of Timor.

Very little difference was noted in the distribution of intestinal parasites according to age and sex. Hookworm prevalence rates showed the greatest variation according to sex (5 per cent). Hookworm prevalence rates also tended to be higher in older age groups (10 or more years). Species of hookworm reported herein are not known; however *Necator americanus, Ancylostoma duodenale, A. ceylanicum,* and *A. caninum* were reported from human autopsies in Jakarta (Lie and Tan, 1959).

Azevedo *et al.* (1958) noted some increase with altitude in the prevalence of intestinal helminths in Portuguese Timor, but gave no explanation, while Cross *et al.* (1970) commented on a lower prevalence of common intestinal parasites at higher elevations on Java. In the present study there is no consistent pattern of helminth or protozoan distribution

according to altitude.

Plasmodial infections were relatively common in Indonesian Timor *P. falciparum* was by far the most common agent, being responsible for more than 50 per cent of the malaria cases. Gundelfinger *et al.* (in press) recently reported in the prevalence of an vectors of malaria in the village of Litamali on the south coast of Indonesian Timor, adjacent to the Portuguese border. Malaria was found to be an important public health problem in the population sampled; 35 per cent of approximately 25 per cent of the population of Litamali *P. falciparum* accounted for 80 per cent of these parasitemias; *P. vivax*, *P. malariae*, and possibly *P. ovale* were also diagnosed in that order of frequency. *A. barbirostris* and *A. subpictus* were suspected to be the important malaria vectors, at least along the coast of Timor in the dry season. In Margolembo, Sulawesi, Cross *et al.* (1972) reported an 18.6 per cent malaria parasitemia rate and here again, *P. falciparum* was responsible for more than 50 per cent of cases. Previous surveys in other areas of Sulawesi and surveys on Java and Sumatra have demonstrated that malaria is nonexistent (Cross *et al.*, 1970) or very low (less than 5 per cent) (Clarke *et al.*, 1973a and 1973b, Carney *et al.*, 1974a; 1974b; 1974c; 1974d; and 1974e).

Timor microfilariae in man were reported from Indonesian Timor, (Oemijati and Tjoen, 1966) following the original documentation of their occurence in the human population of Portuguese Timor. Similar microfilariae were diagnosed in 90 per cent of the filarial cases from Indonesian Timor.

Of the Timor filariasis cases 16 per cent were concurrent infections with *W. bancrofti* which was responsible for 26 per cent of the cases of filariasis. These results compared well with those of Azevedo *et al.* (1969) who incriminated Timor microfilariae including 4 per cent mixed infections, in 89 per cent of the filariasis cases from Portuguese Timor while *W. bancorfti* was responsible for 15 per cent of the diagnosed cases.

In Portuguese Timor, *W. bancrofti* transmission is limited to certain costal areas (azevedo *et al.*, 1969). This also appears to be the case in the Indonesian portion of the island since cases of *W. bancrofti* were limited to costal villages with the exception of one case in the island village of Loli. On the other hand, Timor microfilarid infection was more widespread throughout Indonesian Timor. This agrees with results from Portuguese Timor (Azevedo, 1969) where *Brugia malayi* (= Timor filarid and possibly true *B. malayi)* were widespread.

Azevedo *et al.* (1969) consider the Timor filarid to be a variant of *B. malayi.* However, others disagree. Dunn and Ramachandran (1969) suggest that Timor microfilariae may even belong to a genus other than *Brugia.* Edeson (1972) more recently concluded that the status of the Timor microfilaria is uncertain. It will remain so until the life history is worked out, thus associating the larval stages with their respective adult forms.

Anopheles barbirostris is the only mosquito incriminated as a vector of malayan filariasis (Timor microfilaria included) in Portuguese Timor. However, the vector of Bancroftian filariasis in Portuguese Timor has not been determined (Azevedo *et al.*, 1969).

SUMMARY

A survey for blood and intestinal parasites was made in Indonesia Timor in 1972. A total of 445 stool specimens from 234 males and 211 females ranging in age from 1 to 70 years were examined and 68 per cent harbored one or more intestinal parasites. Hookworm (35 per cent) and *Entamoeba coli* (27 per cent) were the most common followed by *Entamoeba histolytica* (11 per sent), *Ascaris lumbricoides* (10 per cent), *Endolimax nana* (9 per cent), *Taenia* sp. (7 per cent), *Giardia lamblia* (5 per cent), *Chilomastix mesnili* (5 per cent), *Entamoeba hartmanni* (4 per cent) and *Iodamoeba butschlii* (2 per cent). Other intestinal parasites infrequently found were; *Balantidium coli* (1 per cent), *Trichuris trichiura* (1 per cent), *Enterobius vermicularis* (1 per cent), *Hymenolepis nana* (0.2 per cent), a dicrocoeliid trematode (1 per cent), and an unidentified nematodes (0.2 per cent). Parasitemias due to *Plasmodium falciparum, Plasmodium malariae* and *Plasmodium vivax* occured in 12 per cent of the population

sampled. *Wuchereria bancrofti* and Timor filaria, microfilariemias were identified in 8 per cent of the sampled population.

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